PREVENTION AND MANAGEMENT OF POSTOPERATIVE VISION LOSS (POVL) IN PATIENTS UNDERGOING PROCEDURES IN TRENDELENBURG AND PRONE POSITIONS

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Abstract

Background: Postoperative vision loss (POVL) is considered rare, but it is a devastating complication that can occur in any patient undergoing surgery and it is important for anesthesia providers to understand the prevention and management of POVL. It has been shown there has been an increase in prevalence of POVL in patients that are placed in prone and steep Trendelenburg (ST) positions for cardiac, spine, head and neck, and orthopedic procedures. The exact prevalence of POVL is unknown, however, permanent POVL associated with spine surgery has been reported in as many as 1 in 500 operations (0.2 percent) from data obtained from three centers that performed over 3,400 spine surgeries. The most common cause of postoperative ocular injuries usually involves corneal abrasion, which may be associated with vision loss, and increased ocular perfusion pressure (IOPP). The complications associated to POVL can be anything from transient blurring to complete permanent blindness. Patients who experience POVL spend an average of 8.6 days in the hospital, costing an average of $42,532 vs. 4.1 days costing an average of $22,697 for those unaffected.
Local Problem: The purpose of this DNP project was to develop a clinical practice guideline (CPG) to decrease incidences of POVL at a community hospital in Baltimore, Maryland, (which renders nearly half of its cases in STP, during prone, laparoscopic, and robotic-assisted cases), that has reported a growing concern for management of POVL. Currently, the target institution has no uniform standard for the management of POVL. Therefore, the purpose of this CPG was to develop a standardization of the management of patients undergoing procedures in ST and prone positioning.
Interventions: The CPG development consisted of two phases. Phase I (June 2018-August 2018) included the identification of the practice problem, target site, and appropriate stakeholders and their approval in assisting with the project. Barriers and project measures were developed and the initial draft of the CPG was made. The CPG was then presented to the stakeholders for feedback and revisions were made accordingly. The project was then submitted to the University of Maryland School of Nursing (UMSON) Institutional Review Board (IRB) for approval. Phase II (September 2018-April 2019) included the presentation of the CPG to the anesthesia staff members at the target site. The anesthesia staff in attendance was given a Provider Feedback Questionnaire (PFQ) to complete and was collected at the end of the meeting. The results from the PFQ was then synthesized and analyzed to make further revisions to the CPG with suggestions from the stakeholders. The final DNP project manuscript was then submitted for committee review.
Results: Data obtained from the AGREE II tool and PFQ were analyzed with descriptive and correlational statistics. Each domain of the AGREE II tool was individually analyzed and showed that the overall quality of the guidelines was rated highly. Appraisers recommended the CPG for it to be presented to the target institution by receiving scores above 86%. There were a total of 24 persons attending the implementation presentation whom all received the PFQ and 100% of the PFQ was received in completion. The confidence interval was 95% after calculating the total percentage of agreement which was 74% and the standard deviation was 15%. The overall comparisons between CRNA and MD via chi-square analysis was 27.3156 with a p-value <0.01. The result was significant at $p<0.05$. The analysis of the PFQ demonstrated the acceptance of the CPG by both groups of anesthesia providers at the target site regardless of any differences.
Conclusion: The results of the study showed that there is large positive feedback from the group towards the presented CPG. This CPG has great potential and usefulness in reducing the incidence of POVL in patients undergoing surgery at this facility by standardizing the practice. Lowering POVL incidence would mean less occurrences of potential devastating permanent damages to vision that could severely impact the patients' quality of life.

Overview

Postoperative vision loss (POVL) is considered rare, but it is a devastating complication that can occur in any patient undergoing surgery. It is theorized that POVL is a direct result of decreased intraocular perfusion pressure (IOPP) to the optic nerve sheath during operations requiring general anesthesia. There is an increase in prevalence of POVL in patients that are placed in prone and steep Trendelenburg (ST) positions (Kendrick, 2012) after cardiac, spine, head, neck, and orthopedic procedures (Lee & Newman, 2018). The most common cause of postoperative ocular injuries usually involves corneal abrasion, which may be associated with vision loss. Other common causes of permanent POVL are ischemic optic neuropathy, central retinal artery occlusion, and cerebral vision loss (Lee & Newman, 2018). POVL can occur after an injury at any site in the visual pathway from cornea to occipital lobe. The complications associated with POVL can be anything from transient blurring to complete permanent blindness (Lee & Newman, 2018). Elevated IOP during surgery is a risk factor for POVL (Joo et al., 2016) and a tonometer device can be used to measure intraoperative IOPP. Tonometers use the principle of Imbert-Fick law: P=F/A, where P=intraocular pressure, F=amount of force exerted by the tonometer to flatten area of the eye, and A=area flatted. Normal IOP ranges from12-22 mm Hg. The exact prevalence of POVL is unknown, however, permanent POVL associated with spine surgery has been reported in as many as 1 in 500 operations (0.2 percent) from data obtained from three centers that performed over 3,400 spine surgeries (Lee & Newman, 2018).

The purpose of this DNP project was to develop a clinical practice guideline (CPG) to decrease incidences and improve the management of POVL at a community hospital in Baltimore, Maryland hospital that currently does not have a standard of practice in place. There

has been a reported growing concern for the proper management of POVL at this facility with the high volume of cases that are performed in ST and prone position.

The short-term goals for this project was to increase the knowledge base among anesthesia providers regarding POVL, the identification of high-risk patients, current interventions that have shown to decrease the likelihood of patients developing this complication, and the proper management of a suspected POVL in a patient. Further short-term goals were to obtain the approval of the stakeholders for the development and implementation of a CPG that offers anesthesia providers a way to make informed evidence based decisions regarding POVL prevention and management.

The primary goal was to develop a CPG and have it reviewed by an expert panel using the Appraisal of Guidelines for Research and Evaluation (AGREE) II Instrument by February 2018. Revisions were made to the CPG with input from the expert panel by April 2018. The CPG was presented to the anesthesia department at the selected hospital facility in November 2018 with 100 percent of the PFQ forms collected from anesthesia providers attending the meeting. The long-term goals for this project was to finalize the CPG and have it implemented at the selected hospital facility by April 2019. It is anticipated that following adoption of the CPG that it will be utilized by at least 75 percent of the anesthesia providers at the facility to prevent POVL in patients undergoing prone or ST positions in surgery. By December 2019, there should be evidence of decreased incidences of POVL.

Theoretical Framework

The theoretical framework that was chosen for this DNP project is the Plan-Do-Study-Act (PDSA) model. It is a four-stage problem-solving model that is used to carry out change. Three primary questions are addressed when utilizing the PDSA model: What are we trying to

accomplish? How will we know that a change is an improvement? What changes can we make that will result in an improvement (PDSA, n.d.)? The first stage was to establish an overview of the plan, describe the purpose of the CPG, and outline the expected outcomes after its implementation. The second stage was to do a thorough literature review regarding perioperative vision loss and the difference in management between patients undergoing procedures in ST versus prone positioning. The third stage was to develop a CPG and to present a presentation regarding POVL and then a CPG to the anesthesia staff until they are experts regarding the topic at the Baltimore hospital and then distribute the PFQ to the staff at their Thursday meeting.

When the PDSA model is directly applied to implement the CPG for decreasing the incidences of POVL the process will be broken into four stages. The first stage addresses what the CPG is trying to accomplish, which is to establish the goal to decrease POVL. It can be predicted that having anesthesia providers utilize the CPG during procedures involving ST and prone positioning, the patients will not suffer from POVL indicating that the intervention has made an improvement. The second stage was to track the interventions and record the findings and problems that arise during the implementation process and making the necessary revisions. The third stage was to finalize and analyze the data in order to conclude what is the best intervention for the reduction of POVL by continuing to track the use of the CPG among the anesthesia providers and discussing what negative and positive effects they have seen since the intervention. The last step was to implement the intervention, then evaluate the effectiveness, and decide on the next cycle of change.

Literature Review

The focus of this literature review is to distinguish methods of management of patients undergoing procedures in ST and prone positioning in preventing POVL to develop a CPG for a

community hospital in Baltimore, Maryland. The literature review will examine the interventions used in this study to prevent POVL in patients undergoing surgeries in the ST position and then prone positioning. Interventions for ST position include the administration of dexmedetomidine, dorzolamide-timolol, and level supine position (LSP) intervention. The literature reviews will be regarding interventions on preventing POVL in patients in prone positioning such as placing the patient in slight reverse Trendelenburg and the administration of brimonidine.

Joo et al. (2016) conducted a prospective, randomized, double-blinded study that tested the effects of systemic administration of dexmedetomidine on IOP and OPP during laparoscopic surgery in ST position. Sixty adults with ASA physical status of class I or II patients undergoing elective laparoscopic or robot-assisted surgery due to recto-sigmoid colon cancer, prostate cancer, or gynecological cancer were included in this study. The dexmedetomidine group received a 1.0 μg/kg IV loading dose before induction, followed with an infusion of 0.5 μg/kg/hr till the end of the surgery; whereas those in the saline group received the same volume of saline in identical way as the dexmedetomidine group. IOP and OPP were measured 16 times: before anesthetic induction; before administration of the study drug; after administration of anesthetic induction agents; after tracheal intubation; 1, 3, 5, and 10 minutes after tracheal intubation; immediately after intraperitoneal CO_2 insufflation; immediately after the steep Trendelenburg position; 1, 2, and 4 hours after the steep Trendelenburg position; just before the supine position; and 10 and 30 minutes after the supine position. The IOP was measured with a tonometer whereas OPP was calculated using the formula MAP minus IOP (Joo et al, 2016). It was noted that those in the saline group the IOP increased to 11.3 mmHg higher than the saline group during sustained Trendeleburg position, but was only 4.2 mmHg higher in the dexmedetomidine group. The OPP was reduced in both groups and was not statistically significant; however, the

dexmedetomidine group had a less degree in decrease in OPP. Based on this study the researchers concluded that using dexmedetomidine during surgical procedures was beneficial to reduce OPP and recommends the use in clinical practice.

Similarly, a double-blind, randomized experimental study was conducted by Molloy et al. (2016) to evaluate the preventive use of dorzolamide-timolol ophthalmic solution (Cosopt) during laparoscopic surgery in the ST position to prevent increase IOP. Ninety patients with no significant demographic characteristics were randomly chosen to receive dorzolamide-timolol or the control group. The patients were scheduled for elective robotoic-assisted laparoscopic prostate and gynecologic procedures that would last for at least 120 minutes. One drop of topical dorzolamide-timolol (containing 20 mg of dorzolamide and 5mg of timolol) or balanced salt solutions in both eyes were administered in the respective groups immediately following induction of anesthesia. The IOP was measured using a tonometer in 30-minute intervals throughout the surgery after baseline was measured with patient in supine position. There was a significant reduction in elevated IOP and periorbital edema of patents undergoing laparoscopic robotic surgery in ST position.

A repeated measure quasi-experimental prospective design by Molloy & Watson (2012) evaluates LSI during ST for laparoscopic prostatectomy, bowel resection and pelvic gynecological procedures for a minimum of 120 minutes. Baseline IOP was measured in supine position and then again at 30 minute intervals in ST and then at the end of case in supine using a tonometer. The analysis of the result showed statistically significant decrease in mean IOP ($P<.001$) compared to no intervention. Limitation of the study was the fact that the study was limited to one hospital, same surgeons performed the operations for the study, the absence of randomization, and there was no specific screening required to rule out glaucoma and vascular

disease. The study by Molloy and colleagues support the hypothesis that LSI in periodic intervals for 5-7 minutes after every 2 hours will minimize the impact of IOP and OPP on long laparoscopic procedures reducing the likelihood of POVL development.

Carey et al. (2014) designed a single-center, prospective randomized controlled study to assess the effect of table inclination on IOP in patients undergoing prone spine surgery with nineteen patients. The patients were randomly assigned to a table position: neutral, 5 degrees or 10 degrees of reverse Trendelenburg. In intervals of 30 minutes, 60 minutes, and 60-minutes thereafter the IOP, MAP, estimated blood loss (EBL), fluid resuscitation, and ophthalmologic complication are assessed. Surgical times ranged from 33 to 325 minutes and it was noted that there was an increase in IOP after prone positioning which increased over time. The neutral group had a statistically higher IOP in comparison to the two other groups in 5 degree and 10 degree reverse Trendelenburg and it continued till 120 minutes. Between the reverse Trendelenburg groups there was no significant statistical difference.

In a factorial randomized trial by Farag et al. (2012) the effects of crystalloid versus colloid and the alpha-2 agonist brimonidine versus placebo on intraocular pressure during prone spine surgery was conducted. At the Cleveland Clinic sixty-five patients undergoing complex spine surgery were randomized to albumin and topical placebo (n=15); albumin and topical brimonidine (n=16); lactated Ringer's solution and topical placebo (n=13); and lactated Ringer's solution and topical brimonidine (n=16). IOP was measured with a pneumotonometer and the time-weighted average intraoperative IOP was the primary outcome. Prone positioning had an increase in IOP of a mean ±SD of 12±6 mmHg and at the end of anesthesia on average 5.5 hours later showed an increased to 38±10 mmHg. The brimonidine group had a reduced intraoperative

IOP average and reduced IOP at end of surgery. While other groups showed little effect on IOP of significance.

The literature review of the five studies has many similarities as well as differences. All five studies identify that POVL is a devastating complication that occur during surgeries that place patients in either prone or ST positioning. Four of the five studies are randomized controlled studies and have gathered patients for either laparoscopic or spine surgeries. Further, all of the studies utilize a tonometer to measure IOP and used it as a tool to identify patients that were at higher risk of developing POVL. All five studies also noted significant increase in IOP when patient was placed in ST or prone position at baseline before any interventions. The differences among the studies are that Molloy & Watson's (2012) study was not a randomized controlled study and instead was a repeat prospective study. Further, each study was testing a different intervention and its effects on decreasing the rise of IOP when patient was not in supine position. Despite the differences among the five studies it can be concluded that there are preventive interventions to decrease the likelihood of patients developing POVL after surgeries where they are in prone or ST positions. All of the studies reviewed stated the importance of having goal-directed fluid therapy and limiting excessive crystalloid administration because of increased IOP and facial edema. Farag et al.'s (2014) research showed that incorporating colloids such as albumin may help negate these negative side effects. It can also be suggested by the reviewed studies that there are many interventions that can be done perioperatively that could reduce the risk of POVL. Joo et al. (2016) and his colleagues showed that 1.0 μg/kg IV loading dose of dexmedetomidine before anesthesia followed by an infusion of 0.5 μg/kg/hr throughout the operation can reduce IOP. While Molloy et al. (2016) and colleagues showed that a drop of topicaldorzolamide-timolol (containing 20 mg of dorzolamide and 5 mg of timolol) or BSS

administered topically to both eyes immediately following induction of anesthesia can reduce IOP. Further, Molloy and Watson (2012) showed that patients to supine position for 5-7 minute intervals after every two hours significantly reduced IOP as well. Likewise, Carey & Weber (2014) showed that placing the patient in a slight in reverse Trendelenburg position to 5 to 10 degree while in prone position can help prevent IOP. While Farag et al. (2012) showed that one drop in each eye in the preoperative area of Brimonidine 2%, approximately 1 hour before induction of anesthesia and then every 8 hour for 24 hours slightly reduced primary outcome of intraoperative time-weighted average ICP. In conclusion, literature reviews such as these five studies are necessary in order to develop guidelines for anesthesia providers to practice based on current evidence and avoid preventable complications as POVL.

Implementation Plan

The CPG development project focused on the evaluation and management of POVL and will be implemented at a community hospital in Baltimore, Maryland that does not currently utilize a CPG regarding this issue. The targeted patient population for this CPG will be for adults 18 years of age and older who underwent a procedure in the ST or prone positioning that have a higher risk for POVL. The CPG was presented to the Anesthesia Department providers which included CRNAs and anesthesiologists and the importance regarding the proper identification and management of POVL in patients was also reviewed. The CPG development project took place over two phases from June 2018 till March 2019. Phase I was to perform small tests of change, while phase II was focused on implementing the CPG on a full-scale.

Phase I (June 2018-August 2018) included the identification of the practice problem, target site, and appropriate stakeholders. The stakeholders gave feedback and agreed to assist in the project. Barriers and project measures are developed and the initial CPG draft was made. The

CPG was presented to the stakeholders again for feedback and revised with the AGREE II tool. The CPG development project is submitted to the University of Maryland School of Nursing (UMSON) Institutional Review Board (IRB).

Phase II (September 2018- April 2019) included the presentation and education of the CPG to the anesthesia staff providers and the addressment of any questions during a scheduled staff meeting. The anesthesia staff in attendance was given a PFQ in paper form to fill out and be collected at the end of the meeting. The results from the PFQ was used to make further revisions to the CPG with suggestions again from the stakeholders. The final CPG was then used to be implemented and encouraged for use with reminders every week during staff meetings.

Data Collection and Analysis

The quality of the CPG was assessed using the AGREE II tool (Appendix D). The AGREE II tool was developed to address the issue of variability in guideline quality and it is widely used for evaluation of clinical guidelines as it is considered the gold standard for guideline evaluation and has construct validity according to Brouwers et al. (2010). The tool was created by the AGREE Next Steps Consortium and consists of twenty-three items with six domains, and a section for complete evaluation of the CPG. Domain 1 covers scope and purpose. Domain 2 focuses on stakeholder involvement. Domain 3 relates to the rigor of development. Domain 4 deals with the clarity of presentation. Domain 5 pertains to the applicability of the CPG. Domain 6 is concerned with the editorial independence. A Likert scale is used to measure items, and consists of a seven-point response scale ranging from 1 = ‘strongly disagree’ to 7 = ‘strongly agree.’ A score of 1 is where no information is available and the scores increase as more criteria are met. A score of 7 is for exceptional quality of reporting and where considerations and full criteria have been met (AGREE Next Steps Consortium, 2013). The

AGREE II tool was sent to stakeholders that evaluated the guideline and further revisions was made from the feedback on the CPG.

The PFQ is another tool that was distributed to anesthesiologist, CRNAs, and end users. The tool was provided in a paper and pencil format and is an assessment tool used to evaluate drafts of CPGs and the anesthesia providers' attitude towards the information provided during the presentation. The PFQ tool has been established as reliable and valid by the Cronbach's alpha coefficient and appropriate for the purpose of this project. The PFQ has 23 core items that assess: scientific quality, methodological rigor, implementability, applicability, and acceptability of recommendations. A three point Likert scale (strongly agree, strongly disagree, neither agree nor disagree) is used to score the items. The PFQ was important in identifying potential barriers during the implementation process of the CPG. The demographic information among the attendees of the presentation was also obtained. This information includes the number of years of clinical anesthesia practice and the type of anesthesia provider the attendee is. The PFQ was distributed to the anesthesia providers on paper format and collected at the end in a locked secured metal box at the end of the presentation. A descriptive correlative statistics analysis was utilized.

Results

Descriptive and correlational statistics was used to analyze the data obtained via AGREE II tool and PFQ. The analysis of the AGREE II tool that was completed by the stakeholders was done by calculating each of the six AGREE II domains. The domain scores are calculated by summing up all the scores of each individual item and scaling the total as a percentage of the maximum possible score for that domain. The maximum possible score 7 is multiplied by total items multiplied by the number of appraisers. The minimum possible score 1 is multiplied by

total items multiplied by the number of appraisers. The scaled domain score that indicates the quality score will then be calculated by taking the obtained score minus minimum scored divided by the maximum possible score minus the minimum possible score. Computing the AGREE II tools by stakeholders reviewed showed that the maximum possible score is 336 and minimum score is 48. The quality score was 57 percent (Appendix B). The results for each domain and overall are: Domains 1, 2, 4, 5, and 6 received a score of 86% among both appraisers. Domain 3 was the only domain to receive a 96 percent among both appraisers. The overall quality of the guideline was rated highly and the appraisers recommended this CPG to presented to the anesthesia department at the target institution for use in practice.

There were a total of 24 persons attending the implementation presentation whom all received the PFQ and 100 percent of the PFQ was received in completion. The attendees consist of 12 CRNAs, 1 nurse practitioner, 6 anesthesiologists, and 5 student registered nurse anesthetists (SRNA). However, the SRNAs were excluded from the study due to their lack of clinical experience at that time. When anesthesia experience was analyzed it was noted that 2 providers had <5 years experience; 2 providers had 5-10 years experience; 2 providers had 10-15 years experience; 8 providers with 15-20 years experience; and 4 providers reported >20 years experience. The 18 of the 19 attendees that completed the PFQ reported “yes” to item 1 and there was 1 “no” whom was directed not to complete the questionnaire and not included in the data set. There was an overwhelming number of strongly agree with just 1 neither agree or disagree in items 2, 3, 4, 5, 8, 9, 11, 12, 13, 18, 20, and 23. There was a 100 percent strongly agree in items 6 and 7. On the contrary, items 15 and 16 had the most neither agree or disagree with 6 each. There were strongly disagree in items 10, 14, 15, 16, and 17. However, items 10, 13, 14, 15 are reverse scored.

The percentage of agreement for each questionnaire by dividing the total number of "strongly agree" responses by total number of items (22) was 94 percent. The total percentage of agreement by averaging the individual percentages of agreement is 74 percent. The Confidence interval is 95 percent after calculating the total percentage of agreement which is 74 percent and the standard deviation is 15 percent. The overall comparisons between CRNAs and MDAs chi-square analysis was 27.3156 with a p-value <0.01 indicating that there is a relationship between MDAs versus CRNAs in their willingness to incorporate the CPG into their practice. However, overall the results indicate that the CPG is favorable to the anesthesia providers at the target site among both groups.

Discussion

Analysis of the data obtained from the AGREE II tool revealed the two appraisers that reviewed the CPG recommend it without any additional or further changes and fully supported the short- and long-term goals of the project of the CPG development. This allowed the progression of presenting the CPG to the anesthesia department at the target site. The PFQs were analyzed and revealed that 66 percent of the providers have been practicing anesthesia over 16 years and longer. The attendees consisted of 66 percent CRNA and 33 percent physicians. Although there was a high 74 percent agreement, there may be several factors as to why there was disagreement with the CPG. Barriers and limitations were brought up by the attendees and one of them was the lack of resources to carry out the CPG fully and not being readily available. For example, the Tono-pens were recommended as a device to measure IOPP in patients undergoing procedures. However, these tools are costly and would require regular maintenance. In addition, the CPG recommended medications such as topical dorzolamide-timolol which would require receiving approval from the pharmacy department and funding as well. However,

support was not received by the chief anesthesiologist regarding allocating funds to this cause. Further, the percent agreement may have been greater if there was a belief that more surgeons would be supportive of the use of CPG and agreeing to allocating a few minutes for proper measures to be taken perioperatively to prevent POVL. Due to the low incidence and lack of scientific evidence it has made recommendations difficult to make and also difficult to compare our findings to those of previous studies.

Conclusion

There was acceptance among both appraisers of the CPG via AGREE II tool and the target site attendees via PFQ. There were some limitations to this study such as small sample size and possible bias amongst the respondents. However, there was a large positive feedback from the group proven by high percentage of agreement. Having the CPG readily available to all healthcare providers as educational material, budgeting for Tono-pens and dorzolamide-timolol at the facility by working with the chief anesthesiologist at the facility and pharmacy department to determine the costs of the recommended treatments, and gathering positive attitude and willingness of the anesthesia team can make the CPG a great tool to lower the incidence of POVL at this institution.

Human Rights Protection

A project description was submitted to University of Maryland Baltimore (UMB) Institutional Review Board (IRB) for Non-Human Subjects Research (NHSR) determination. To protect the voluntary participants of this project, the privacy was protected by not collecting any identifiers. Further, the PFQs collected at the staff meeting after the presentation was stored in a locked box and discarded once imputed into a password-protected compute for data analysis.

Approval to implement the DNP project was sought at the hospital in Baltimore that is the intervention site.

Sustainability

The practices outlined by the CPG will be sustained through efforts by the hospital's anesthesia department and new continued education and new hire education on CPG. The outcomes and current research that supports this CPG will be reviewed every year by the anesthesia staff to maintain relevance.

Generalization

The development of this CPG is for quality improvement purposes per the request of the hospital administration regarding PONV prevention and therefore is not intended to be generalizable to other institutions or populations. Therefore, this CPG is intended solely to meet the needs of this institution.

References

Alwon, K. & Hewer, I. (2016). Perioperative vision loss: Considerations and Management. *AANA Journal Course Update for Nurse Anesthetists*, *84*(5).

Carey, T.W., Shaw, K.A., Weber, M.L., & DeVine, J.G. (2014). Effect of the degree of rever Trendelenburg position on intraocular pressure during prone spine surgery: a randomized controlled trial. *Spine Journal, 14*, 2118–2126.

Cong, X., Molloy, B.L., & Watson, C. (2016). Preventive Dorzolamide-Timolol for Rising Intraocular Pressure During Steep Trendelenburg Position Surgery. *American Association of Nurse Anesthetists*, *8*, 3.

Farag, E., Sessler, D., Kovaci, B., Wang, L., Mascha, E., Bell, G., Kalfas, I., Rockwood, E., & Kurz, A. (2012). Effects of Crystalloid versus Colloid and the [alpha]-2 Agonist Brimonidine versus Placebo on Intraocular Pressure during Prone Spine Surgery: A Factorial Randomized Trial. *Anesthesology, 116*(4), 807-815.

Joo, J., Koh, H., Lee, K., & Lee, J. (2016). Effects of Systemic Administration of Dexmedetomidine on Intraocular Pressure and Ocular Perfusion Pressure during Laparoscopic Surgery in a Steep Trendelenburg Position: Prospective, Randomized, Double-Blinded Study. *Journal of Korean Medical Science, 31*(6), 989-996.

Kendrick, H. (2012). Post-operative vision loss (POVL) following surgical procedures. *Journal of Anesthesia Clinical Research, 3*(184).

Lee, L. & Newan, N.J. (2018). Postoperative visual loss after anesthesia for nonocular surgery. UpToDate. Retrieved from https://www.uptodate.com/contents/postoperative-visual-loss after-anesthesia-for-nonocular-surgery

Molloy, B. & Watson,C. (2012). A Comparative Assessment of Intraocular Pressure in

Prolonged Steep Trendelenburg Position Versus Level Supine Position Intervention. *Journal of Anesthesiology and Clinical Science*. Retrieved from http://www.hoajonline.com/journals/pdf/2049-9752-1-9.pdf

Minnesota Department of Health. (n.d.). PDSA: Plan-Do-Study-Act. Retrieved from http://www.health.state.mn.us/divs/opi/qi/toolbox/pdsa.html

Table A1. *Evidence Review Table*

Author, year	Study objective/intervention or exposures compared	Design	Sample (N)	Outcomes studied (how measured)	Results	*Level and Quality Rating
Carey, Shaw, Weber & DeVine, 2014	To assess the effect of different degrees of RT position on IOP in patients undergoing prone spine surgery.	Single-center, prospective, randomized controlled study	Patients with no history of eye pathology, undergoing prone spine surgery. Neutral prone position (n=7), 5 deg RT (n=6), 10 deg RT (n=6)	IOP measured by tonometric. Bed inclination measured by level and goniometer	Rapid increase in IOP noted after prone positioning and increased as time elapsed. However, no significant differences between the 5 deg and 10 deg RT groups for surgery up to 120 minutes.	2 C
Joo, Koh, Lee & Lee, 2016	To assess the effects of continuous infusion of dexmedetomidine on IOP, OPP, and underlying hypertension on IOP compared to normotensive patients undergoing laparoscopic or robotic surgery in ST position.	Prospective, randomized, double-blinded study	Adult patients, ASA I or II, undergoing elective laparoscopic or robotic-assisted surgery due to recto-sigmoid colon cancer, prostate cancer, gynecological cancer. Saline group (n=27) versus dexmedetomidine group (n=28)	Right internal jugular vein catheterized for fluid management, measurement of CVP. IOP measured with handheld tonometer. MAP, HR, EtCO2, PIP, Pmean data set was collected	IOP increased significantly in steep Trendelenburg position and maintained during the sustained Trendelenburg position. OPP reduced during steep Trendelenburg position in both groups. Degree of decrease in OPP during steep Trendelenburg position compared with baseline OPP was less in dexmedetomidine group than in saline group. Patients with underlying hypertension showed slightly higher IOP during entire period of surgery compared to normotensive patients in both groups; not statistically significant.	2 A
Cong, Molloy & Watson, 2016	To evaluate preventive use of dorzolamide-timolol ophthalmic solution (Cosopt) in rising intraocular pressure in patient undergoing laparoscopic surgery in steep trendelenburg position.	Double-blind, randomized, experimental study	Patients with ASA physical status (classes 1-5) undergoing lower abdominal laparoscopic procedures using ST position. Receiving dorzolamide-timolol treatment (n=46) versus balanced salt solution (n=44)	IOP measured with applanation tonometer, MAP by arterial catheter or NIBP, protractor measure degree of ST position	Dorzolamide-timolol drops significantly reduced elevated IOP in treatment group than controls ($P<0.05$ *to* $P<.001$) in patients undergoing laparoscopic robotic surgery in ST position.	2 A
Molloy & Watson, 2012	To evaluate level supine intervention (LSI) during laparoscopic surgery in steepTrendelenburg position (Lap ST). IOP and OPP moniotored during the surgery. A LSI for one 5 minute interval at the 60 minute time point was introduced and hypothesized it would normalize IOP.	Repeat measure prospective design study	Patients with ASA 1-5 underoing laparoscopic prostatectomy, bowel resections and pelvic gynecological procedures in ST from a minimum of 120 minutes surgical time. Control participants (n=37) and level supine intervention participants (n=29) were included.	MAP measured with arterial catheter, tonometer for IOP monitoring.	IOP in the Lap ST without LSI at 120 minutes at 25-54 mmHg (31.6±10.18) and at the end of the case 11% returned to baseline IOP. The intervention group ranged IOP 10-33 mmHg (18.4±4.98) at 120 minutes and 75% went down to baseline IOP. These results were statistically significant decrease in mean IOP (P<.001).	3A
Farag,Sessler, Kovaci, Wang, Mascha, Bell, Kalfas, Rockwood & Kurz, 2012	To test hypothesis that during prolonged prone surgery, IOP will increase less with intravenous administration of 5% albumin than with lactated Ringer's solution, and with topical alpha-2	Factorial Randomized Trial	Patients undergoing complex spine surgery were randomized to albumin and topical placebo (n=15); albumin and topical brimonidine (n=16); lactated Ringer's soluction and topical placebo (n=13); and lactated	IOP was measured with a pneumotonometer	Prone positioning had an increase in IOP of a mean ±SD of 12±6 mmHg and at the end of anesthesia on average 5.5 hours later showed an increased to 38±10 mmHg. The brimonidine group had a reduced intraoperative IOP average and reduced IOP at end of surgery. While other groups showed little effect on IOP of significance.	2A

	agonist brimonidine that with placebo eye drops.		Ringer's solution and topical brimonidine (n=16).			

Table A2. *Rating System for Hierarchy of Evidence*

Level of the Evidence	Type of the Evidence
I (1)	Evidence from systematic review, meta-analysis of randomized controlled trails (RCTs), or practice-guidelines based on systematic review of RCTs.
II (2)	Evidence obtained from well-designed RCT
III (3)	Evidence obtained from well-designed controlled trials without randomization
IV (4)	Evidence from well-designed case-control and cohort studies
V (5)	Evidence from systematic reviews of descriptive and qualitative studies
VI (6)	Evidence from a single descriptive or qualitative study
VII (7)	Evidence from the opinion of authorities and/or reports of expert committees

Melnyk, B.M. & Fineout-Overholt, E. (2014). *Evidence-based practice in nursing & healthcare: A guide to best practice* (3rd ed.). New York: Lippincott, Williams & Wilkins.

Rating Scale for Quality of Evidence

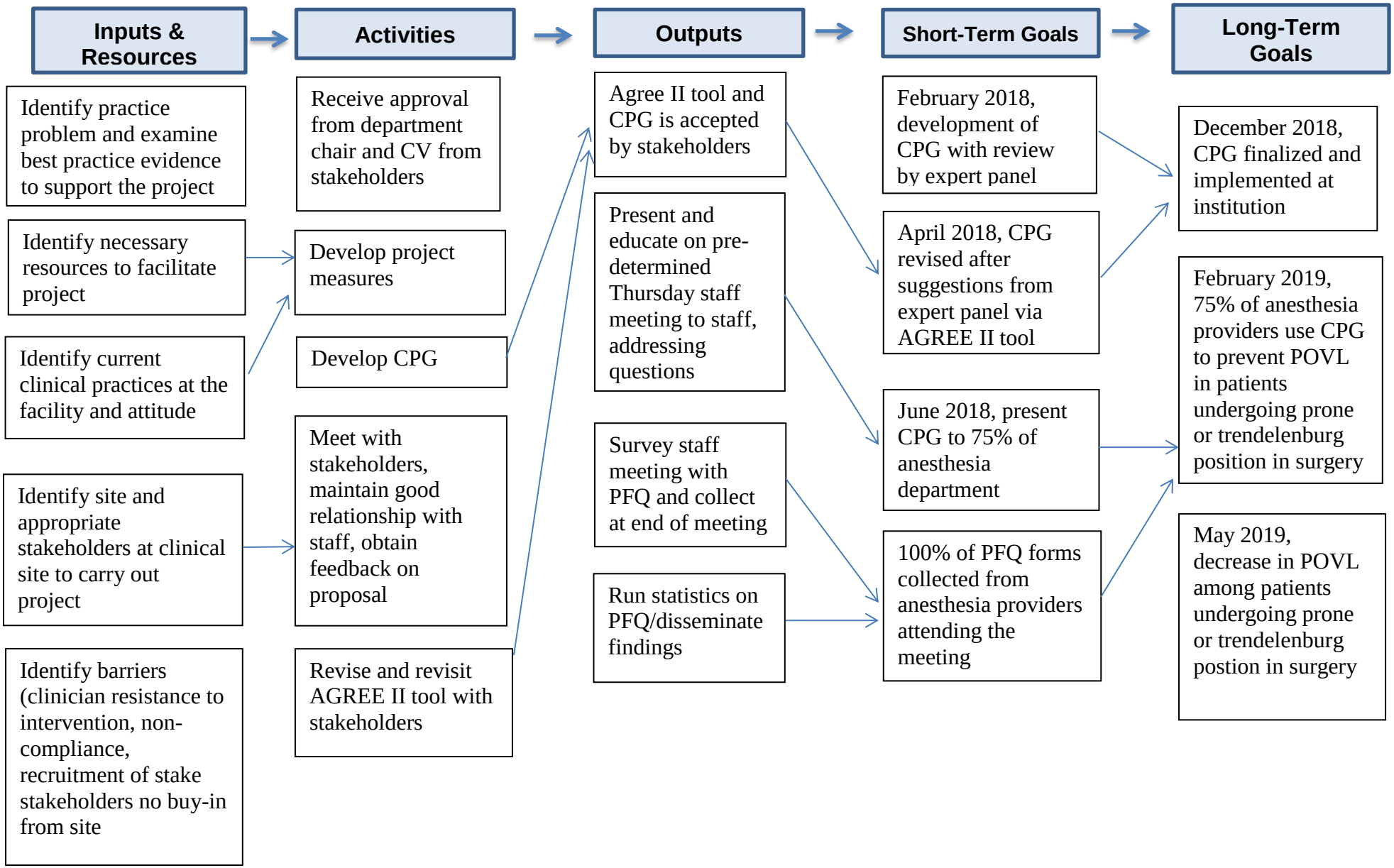
A: High – consistent results with sufficient sample, adequate control, and definitive conclusions; consistent recommendations based on extensive literature review that includes thoughtful reference to scientific literature

B: Good – reasonably consistent results; sufficient sample, some control, with fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence

C: Low/major flaw – Little evidence with inconsistent results; insufficient sample size; conclusions cannot be drawn

Newhouse, R.P. (2006). Examining the support for evidence-based nursing practice. *Journal of Nursing Administration*, *36*(7-8), 337-4

Project Name: A Comparison of the Management of Patients Undergoing Procedures in Trendelenburg versus Prone Positioning to Prevent POVL
Project Leader: Dr. Joseph Pellegrini, PhD, DNP, CRNA, Dr. Masozi Richard Muwowo, MDA & Megan Kerwin, MSN, CRNA
Project AIM or Purpose: Implement a clinical practice guideline (CPG) for anesthesia providers to enhance awareness and reduce the frequency of POVL in patients undergoing procedures in prone and Trendelenburg positions in a small, community hospital in Baltimore, Maryland by April 2019.
Why the Project Is Needed: It is the standard of care to ensure patients are properly positioned and monitored during surgery. It benefits patients by protecting the patient from developing injuries such as POVL.



Appendix A. *Clinical Practice Guidelines*

Interventions for both Steep Trendelenburg and Prone Position Surgery

- Limit excessive crystalloid administration
- Incorporate colloids with fluid administration such as albumin

For Steep Trendelenburg Position Surgery

- Administer 1.0 µg/kg IV loading dose of dexmedetomidine before anesthesia, followed by an infusion of 0.5 µg/kg/hr throughout the operation
- One drop of topical dorzolamide-timolol (containing 20 mg of dorzolamide and 5 mg of timolol) or BSS was administered topically to both eyes immediately following induction of anesthesia
- Returne patients to supine position for 5-7 minute intervals after every two hours

For Prone Position Surgery

- Place patient in reverse Trendelenburg position to 5 to 10 degree while in prone position
- One drop in each eye in the preoperative area of Brimonidine 2%, approximately 1 hour before induction of anesthesia and then every 8 hour for 24 hours
- Assess and document eyes are free of pressure throughout procedure
- Use soft prone pillow that gives visualization and access to eyes to prevent direct external compression and a mirror to view the eyes while patient is prone

Appendix B. *AGREE II Tool Results*

	Appraiser 1	Appraiser 2	**Total**
Item 1	6	6	**12**
Item 2	6	6	**12**
Item 3	6	6	**12**
Item 4	6	6	**12**
Item 5	6	6	**12**
Item 6	6	6	**12**
Item 7	6	6	**12**
Item 8	6	6	**12**
Item 9	6	6	**12**
Item 10	6	6	**12**
Item 11	6	6	**12**
Item 12	6	6	**12**
Item 13	6	6	**12**
Item 14	6	6	**12**
Item 15	6	6	**12**
Item 16	6	6	**12**
Item 17	6	6	**12**
Item 18	6	6	**12**
Item 19	6	6	**12**
Item 20	6	6	**12**
Item 21	6	6	**12**
Item 22	6	6	**12**
Item 23	6	6	**12**
Item 24	6	6	**12**
Total	**144**	**144**	**288**

Maximum possible score = 7 (strongly agree) x 24 (items) x 2 (appraisers) = 336
Minimum possible score = 1 (strongly disagree) x 24 (items) x 2 (appraisers) = 48

$$\frac{\text{Obtained score} - \text{Minimum possible score}}{\text{Maximum possible score} - \text{Minimum possible score}}$$

$$\frac{288 - 48}{336 - 48} \times 100 = \frac{240}{288} \times 100 = 0.8333 \times 100 = 83\%$$

Appendix C. *PFQ Data*

Practitioner Feedback Questionnaire

Please select the appropriate demographic category that most accurately describes you.

Type of anesthesia provider:				Years practiced in current role:					
CRNA	NP	Anesthesiologist	SRNA	<5	5-10	10-15	15-20	20-25	>25
12	1	6	**n/a**	2	2	2	8	4	☐

For each item, please check off the box that most adequately reflects your opinion.

1. Are you responsible for the care of patients for whom this draft guideline report is relevant? This may include the referral, diagnosis, treatment, or follow-up of patients.	Yes 18	No 1	Unsure
If you answered "*No*" or "*Unsure*", there is no need to answer or return this questionnaire. If you answered "*Yes*", please answer the questions below and return to **[enter expected destination of surveys]**.			
	Strongly agree	Neither agree or disagree	Strongly disagree
2. The rationale for developing a guideline is clear.	17	1	
3. There is a need for a guideline on this topic.	16	2	
4. The literature search is relevant and complete (e.g., no key evidence was missed nor any included that should not have been) in this draft guideline.	17	1	
5. I agree with the methodology used to summarize the evidence included in this draft guideline.	16	1	
6. The results of the evidence described in this draft guideline are interpreted according to my understanding of the evidence.	18		
7. The draft recommendations in this report are clear.	18		
8. I agree with the draft recommendations as stated.	16	2	
9. The draft recommendations are suitable for the patients for whom they are intended.	16	1	
10. The draft recommendations are too rigid to apply to individual patients.	11	4	3
11. When applied, the draft recommendations will produce more benefits for patients than harms.	16	2	
12. The draft guideline presents options that will be acceptable to patients.	17	1	
13. To apply the draft recommendations will require reorganization of services/care in my practice setting.	16	1	
14. To apply the draft guideline recommendations will be technically challenging.	12	4	2
15. The draft guideline recommendations are too expensive to apply.	10	6	2
16. The draft guideline recommendations are likely to be supported by a majority of my colleagues.	13	3	2
17. If I follow the draft guideline recommendations, the expected effects on patient outcomes will be obvious.	11	6	1
18. The draft guideline recommendations reflect a more effective approach for improving patient outcomes than is current usual practice. (If they are the same as current practice, please tick NA). *NA* ☐	17	1	
19. When applied, the draft guideline recommendations will result in better use of resources than current usual practice. (If they are the same as current practice, please tick NA). *NA* ☐	14	4	
20. I would feel comfortable if my patients received the care recommended in the draft guideline.	17	1	
21. This draft guideline should be approved as a practice guideline.	16	3	
22. If this draft guideline were to be approved as a practice guideline, I would use it in my own practice.	16	3	
23. If this draft guideline were to be approved as a practice guideline, I would apply the recommendations to my patients.	17	1	

Appendix D. *Agree II Tool*

CHECKLIST ITEM AND DESCRIPTION	REPORTING CRITERIA
DOMAIN 1: SCOPE AND PURPOSE	
1. OBJECTIVES *Report the overall objective(s) of the guideline. The expected health benefits from the guideline are to be specific to the clinical problem or health topic.*	Health intent(s) (i.e., prevention, screening, diagnosis, treatment, etc.) Expected benefit(s) or outcome(s) Target(s) (e.g., patient population, society)
2. QUESTIONS *Report the health question(s) covered by the guideline, particularly for the key recommendations.*	Target population Intervention(s) or exposure(s) Comparisons (if appropriate) Outcome(s) Health care setting or context
3. POPULATION *Describe the population (i.e., patients, public, etc.) to whom the guideline is meant to apply.*	Target population, sex and age Clinical condition (if relevant) Severity/stage of disease (if relevant) Comorbidities (if relevant) Excluded populations (if relevant)
DOMAIN 2: STAKEHOLDER INVOLVEMENT	
4. GROUP MEMBERSHIP *Report all individuals who were involved in the development process. This may include members of the steering group, the research team involved in selecting and reviewing/rating the evidence and individuals involved in formulating the final recommendations.*	Name of participant Discipline/content expertise (e.g., neurosurgeon, methodologist) Institution (e.g., St. Peter's hospital) Geographical location (e.g., Seattle, WA) A description of the member's role in the guideline development group
5. TARGET POPULATION PREFERENCES AND VIEWS *Report how the views and preferences of the target population were sought/considered and what the resulting outcomes were.*	Statement of type of strategy used to capture patients'/publics' views and preferences (e.g., participation in the guideline development group, literature review of values and preferences) Methods by which preferences and views were sought (e.g., evidence from literature, surveys, focus groups) Outcomes/information gathered on patient/public information How the information gathered was used to inform the guideline development process and/or formation of the recommendations

6. TARGET USERS *Report the target (or intended) users of the guideline.*	The intended guideline audience (e.g. specialists, family physicians, patients, clinical or institutional leaders/administrators) How the guideline may be used by its target audience (e.g., to inform clinical decisions, to inform policy, to inform standards of care)
DOMAIN 3: RIGOUR OF DEVELOPMENT	
7. SEARCH METHODS *Report details of the strategy used to search for evidence.*	Named electronic database(s) or evidence source(s) where the search was performed (e.g., MEDLINE, EMBASE, PsychINFO, CINAHL) Time periods searched (e.g., January 1, 2004 to March 31, 2008) Search terms used (e.g., text words, indexing terms, subheadings) Full search strategy included (e.g., possibly located in appendix)
8. EVIDENCE SELECTION CRITERIA *Report the criteria used to select (i.e., include and exclude) the evidence. Provide rationale, where appropriate.*	Target population (patient, public, etc.) characteristics Study design Comparisons (if relevant) Outcomes Language (if relevant) Context (if relevant)
9. STRENGTHS & LIMITATIONS OF THE EVIDENCE *Describe the strengths and limitations of the evidence. Consider from the perspective of the individual studies and the body of evidence aggregated across all the studies. Tools exist that can facilitate the reporting of this concept.*	Study design(s) included in body of evidence Study methodology limitations (sampling, blinding, allocation concealment, analytical methods) Appropriateness/relevance of primary and secondary outcomes considered Consistency of results across studies Direction of results across studies Magnitude of benefit versus magnitude of harm Applicability to practice context
10. FORMULATION OF RECOMMENDATIONS *Describe the methods used to formulate the recommendations and how final decisions were reached. Specify any areas of disagreement and the methods used to resolve them.*	Recommendation development process (e.g., steps used in modified Delphi technique, voting procedures that were considered) Outcomes of the recommendation development process (e.g., extent to which consensus was reached using modified Delphi technique, outcome of voting procedures) How the process influenced the recommendations (e.g., results of Delphi technique influence final recommendation, alignment with recommendations and the final vote)
11. CONSIDERATION OF BENEFITS AND HARMS *Report the health benefits, side effects, and risks that were considered when formulating the recommendations.*	Supporting data and report of benefits Supporting data and report of harms/side effects/risks Reporting of the balance/trade-off between benefits and harms/side effects/risks Recommendations reflect considerations of both benefits and harms/side effects/risks

12. LINK BETWEEN RECOMMENDATIONS AND EVIDENCE *Describe the explicit link between the recommendations and the evidence on which they are based.*	How the guideline development group linked and used the evidence to inform recommendations Link between each recommendation and key evidence (text description and/or reference list) Link between recommendations and evidence summaries and/or evidence tables in the results section of the guideline
13. EXTERNAL REVIEW *Report the methodology used to conduct the external review.*	Purpose and intent of the external review (e.g., to improve quality, gather feedback on draft recommendations, assess applicability and feasibility, disseminate evidence) Methods taken to undertake the external review (e.g., rating scale, open-ended questions) Description of the external reviewers (e.g., number, type of reviewers, affiliations) Outcomes/information gathered from the external review (e.g., summary of key findings) How the information gathered was used to inform the guideline development process and/or formation of the recommendations (e.g., guideline panel considered results of review in forming final recommendations)
14. UPDATING PROCEDURE *Describe the procedure for updating the guideline.*	A statement that the guideline will be updated Explicit time interval or explicit criteria to guide decisions about when an update will occur Methodology for the updating procedure
DOMAIN 4: CLARITY OF PRESENTATION	
15. SPECIFIC AND UNAMBIGUOUS RECOMMENDATIONS *Describe which options are appropriate in which situations and in which population groups, as informed by the body of evidence.*	A statement of the recommended action Intent or purpose of the recommended action (e.g., to improve quality of life, to decrease side effects) Relevant population (e.g., patients, public) Caveats or qualifying statements, if relevant (e.g., patients or conditions for whom the recommendations would not apply) If there is uncertainty about the best care option(s), the uncertainty should be stated in the guideline
16. MANAGEMENT OPTIONS *Describe the different options for managing the condition or health issue.*	Description of management options Population or clinical situation most appropriate to each option
17. IDENTIFIABLE KEY RECOMMENDATIONS *Present the key recommendations so that they are easy to identify.*	Recommendations in a summarized box, typed in bold, underlined, or presented as flow charts or algorithms Specific recommendations grouped together in one section
DOMAIN 5: APPLICABILITY	

18. FACILITATORS AND BARRIERS TO APPLICATION *Describe the facilitators and barriers to the guideline's application.*	Types of facilitators and barriers that were considered Methods by which information regarding the facilitators and barriers to implementing recommendations were sought (e.g., feedback from key stakeholders, pilot testing of guidelines before widespread implementation) Information/description of the types of facilitators and barriers that emerged from the inquiry (e.g., practitioners have the skills to deliver the recommended care, sufficient equipment is not available to ensure all eligible members of the population receive mammography) How the information influenced the guideline development process and/or formation of the recommendations
19. IMPLEMENTATION ADVICE/TOOLS *Provide advice and/or tools on how the recommendations can be applied in practice.*	Additional materials to support the implementation of the guideline in practice. For example: Guideline summary documents Links to check lists, algorithms Links to how-to manuals Solutions linked to barrier analysis (see Item 18) Tools to capitalize on guideline facilitators (see Item 18) Outcome of pilot test and lessons learned
20. RESOURCE IMPLICATIONS *Describe any potential resource implications of applying the recommendations.*	Types of cost information that were considered (e.g., economic evaluations, drug acquisition costs) Methods by which the cost information was sought (e.g., a health economist was part of the guideline development panel, use of health technology assessments for specific drugs, etc.) Information/description of the cost information that emerged from the inquiry (e.g., specific drug acquisition costs per treatment course) How the information gathered was used to inform the guideline development process and/or formation of the recommendations
21. MONITORING/ AUDITING CRITERIA *Provide monitoring and/or auditing criteria to measure the application of guideline recommendations.*	Criteria to assess guideline implementation or adherence to recommendations Criteria for assessing impact of implementing the recommendations Advice on the frequency and interval of measurement Operational definitions of how the criteria should be measured
DOMAIN 6: EDITORIAL INDEPENDENCE	
22. FUNDING BODY *Report the funding body's influence on the content of the guideline.*	The name of the funding body or source of funding (or explicit statement of no funding) A statement that the funding body did not influence the content of the guideline
23. COMPETING INTERESTS *Provide an explicit statement that all group members have declared whether they have any competing interests.*	Types of competing interests considered Methods by which potential competing interests were sought A description of the competing interests How the competing interests influenced the guideline process and development of recommendations

(AGREE Next Steps Consortium, 2009)